PadPuls M4L

Art.No.: IM002G

(Valid from M-Bus generation: $12)

Art.-No. IM002G: 4-channel pulse collector for wall / rail mounting

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1 Functional description

The PadPuls M4L serves for the adaptation to the M-Bus system of consumption measuring instruments, such as, current, gas or water meters. However, the meters to be adapted must have a floating pulse output. Up to four impulse meters can simultaneous be connected to the inputs of this device.

Optionally the user can activate a tariff function, by which energy or volume pulses are accumulated in separate meter readings for primary and secondary tariffs. In this case a floating signal for tariff switch is used at Port 2 and / or Port 4.

Each port or each tariff of the PadPuls M4L can be read on M-Bus using its own primary and secondary address. The PadPuls M4L thus acts as four stand-alone M-Bus Slaves! The user configures the pulse collector with the software MBCONF. The accumulated pulses are converted into kWh, m^3, J or other physical units. The user interface of MBCONF allows the operator to get an easy access to the configuration. Alternatively the communication and configuration can be done using the optical interface of the pulse adapter. It is also suited for mobile reading with a handheld or laptop and an optical reading head.

When connected to the M-Bus the PadPuls M4L is powered from the bus. A built-in battery ensures that metering continues if the M-Bus is interrupted.

Another feature of the PadPuls M4L is the due-date function. Meter data are saved separately at the preset due-date at 00:00 hour (day change to the due-date) by the implemented clock with calendar function. The due-date can be changed without lost of the already stored counters. Additionally the M-Bus Master can initiate an immediate execution of the due-date function by sending of the so-called „Freeze“ command. A „Freeze“ sent to all pulse collectors using the broadcast address 254 is helpful for generating reading profiles of an M-Bus system. Afterwards the master software polls the data of all meters.

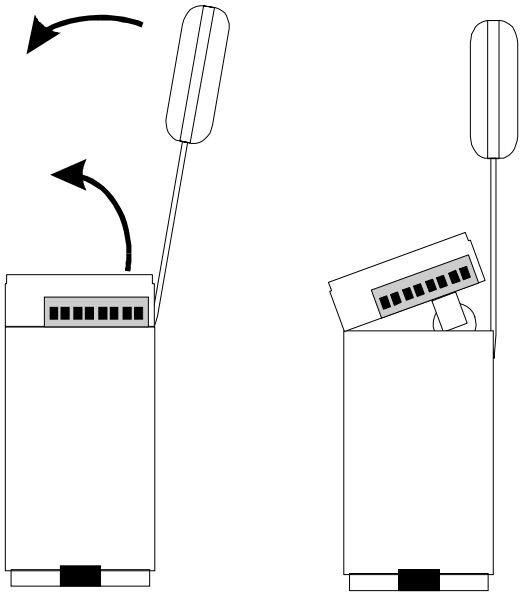
The complete configuration data is saved into a non-volatile memory (EEPROM). Additional security is provided by daily saving of meter readings into this EEPROM. In case of M-Bus fail and empty battery the last saved data is restored on power up.

The configuration data can be protected against unauthorized manipulation. The PadPuls M4L can therefore be switched to protection mode with a special M-Bus telegram. Subsequent changes to device parameters cannot be made in this operating mode. The protection mode can then only be disabled by opening the sealed housing and pressing the unprotect pushbutton for minimum 4 seconds.

2 Installation and Startup

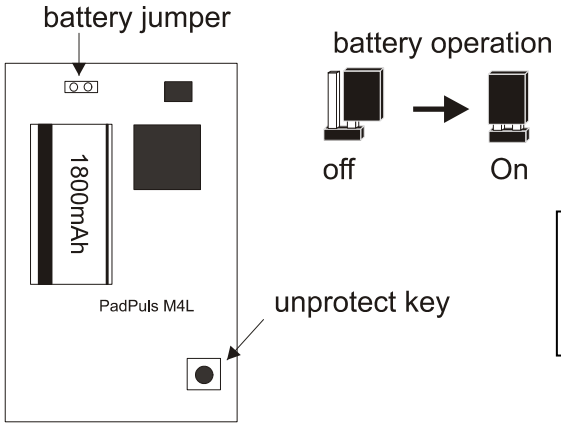
2.1 Opening the case

The case cover can be removed from the lower housing half with the help of a small screwdriver. The screwdriver is placed, as in the drawing, into the small opening at the cover side. After light moving of the screwdriver in the displayed direction the cover can be taken off.



2.2 Activating

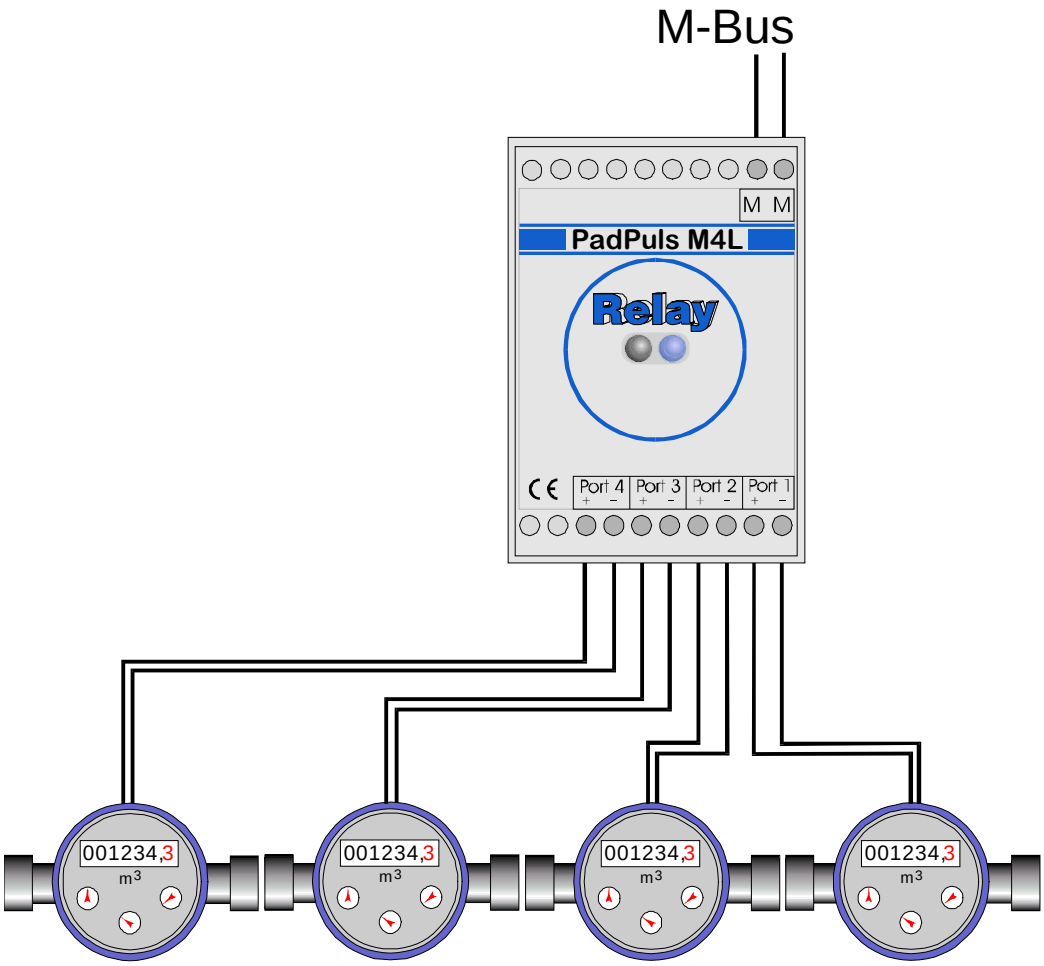
Coming from factory the PadPuls M4L must first be activated. The housing must be opened (see drawing) and the jumper has to be placed on both pins. Then battery operation and data saving is activated on M-Bus failure. On the back of the PadPuls M4L board there are the follwing control elements:



If the device is not used for a longer time, it is advisable to deactivate battery operation by removing the jumper to preserve the battery.

2.3 Connecting

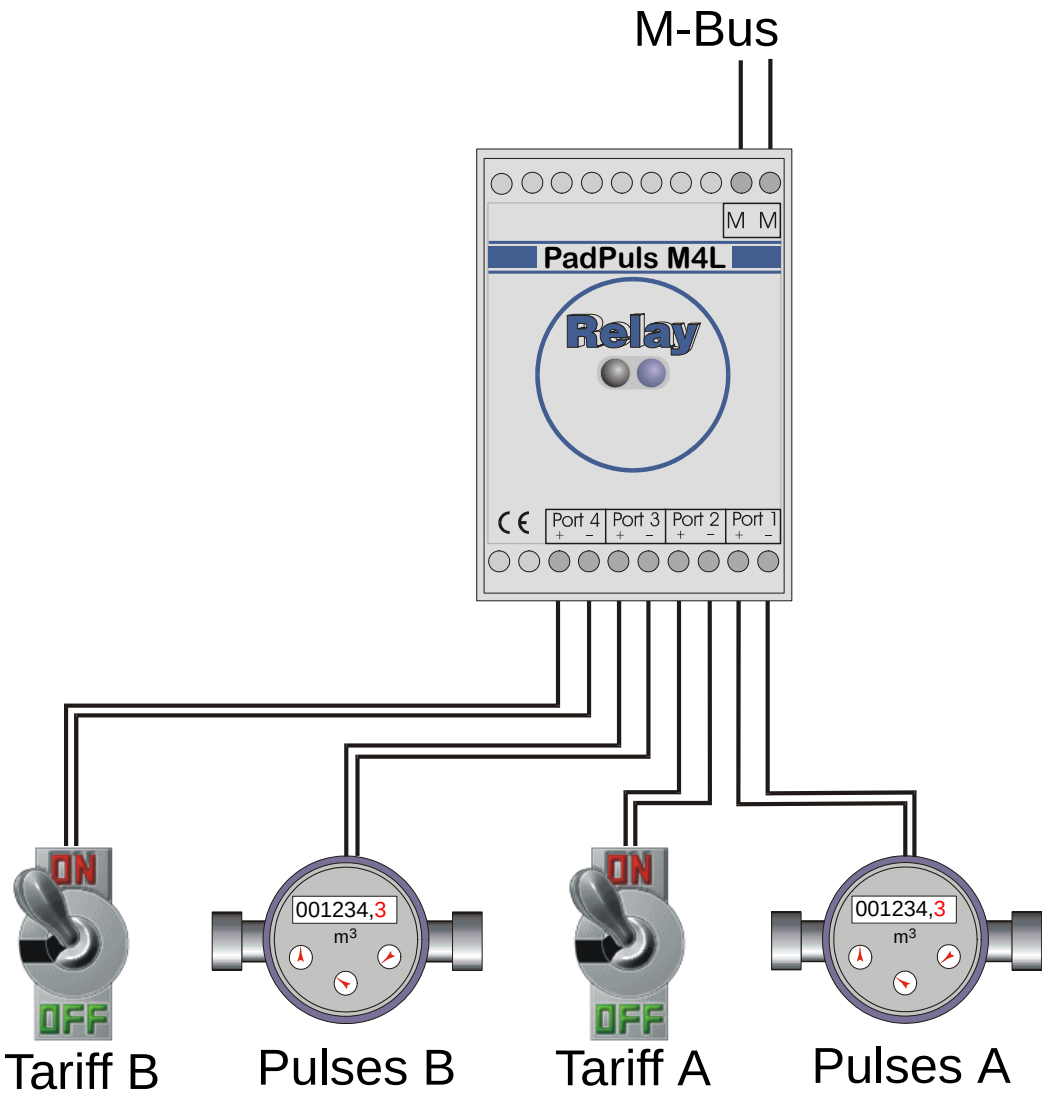
The following figure shows the link of four counters with impulse outputs to the PadPuls M4L. We recommend to use 2-wire cables (twisted pair, NYM or j-Y(St)Y) with a max. length of 10m. In any case it must be noted that the total capacity of the cable plus impulse generator attached at any port may not exceed 2nF (optional 12nF with activated “long pulse sampling”).



- If not all ports of PadPulse M4L are used, you should not attach a cable to the respective unused port. The capacity of an open-circuited cable reduces the lifetime of the battery in stand-alone operation (no M-Bus available).

- If the pulse frequency is over 14 Hz, false countings can occur.

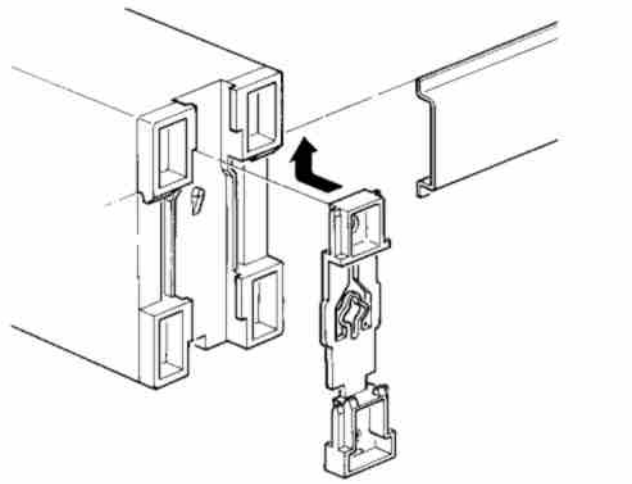
The following graph represents the diagram of connections in the tariff mode with two counters and two tariff signal generators:



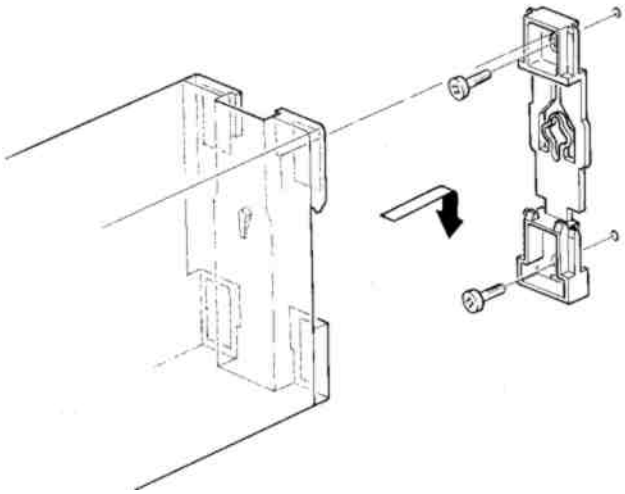
The PadPuls M4L is supplied from M-Bus if it is available. In this normal state the internal battery is then not loaded. Only when the M-Bus fails the battery takes over automatically the supply. There is no lost of data and the counting function is continued. The PadPuls M4L draws approximately 2.75mA current (maximum 2 unit loads) from the
M-Bus.

2.4 Mounting

On the back of the housing there is a special mechanism for mounting the device on a DIN rail according to DIN EN 50022. This mechanism can be removed, turned over and fixed on the wall with two screws. Afterwards you can mount the device without using a rail. The following figures show the two options:



Rail mounting



Wall mounting

3 Parameterization using MBCONF

The configuration of the device must be adapted by the customer to the respective installation. The current version $12 of PadPuls M4L requires the use of the program MBCONF for configuration. The older DOS version PADCON may not be used anymore.

3.1 Installation

The software MBCONF for configuration of the pulse adaptor is a 32-bit application, which can be executed on IBM-PC compatible computers under the operating systems Windows 95 / 98 / NT 4.0. The desktop PC or laptop must have a free serial RS232C interface to connect the M-Bus level converter. The PadPuls M4L to be parameterized must be connected directly (i.e. as only M-Bus device) to the M-Bus output of the level converter.

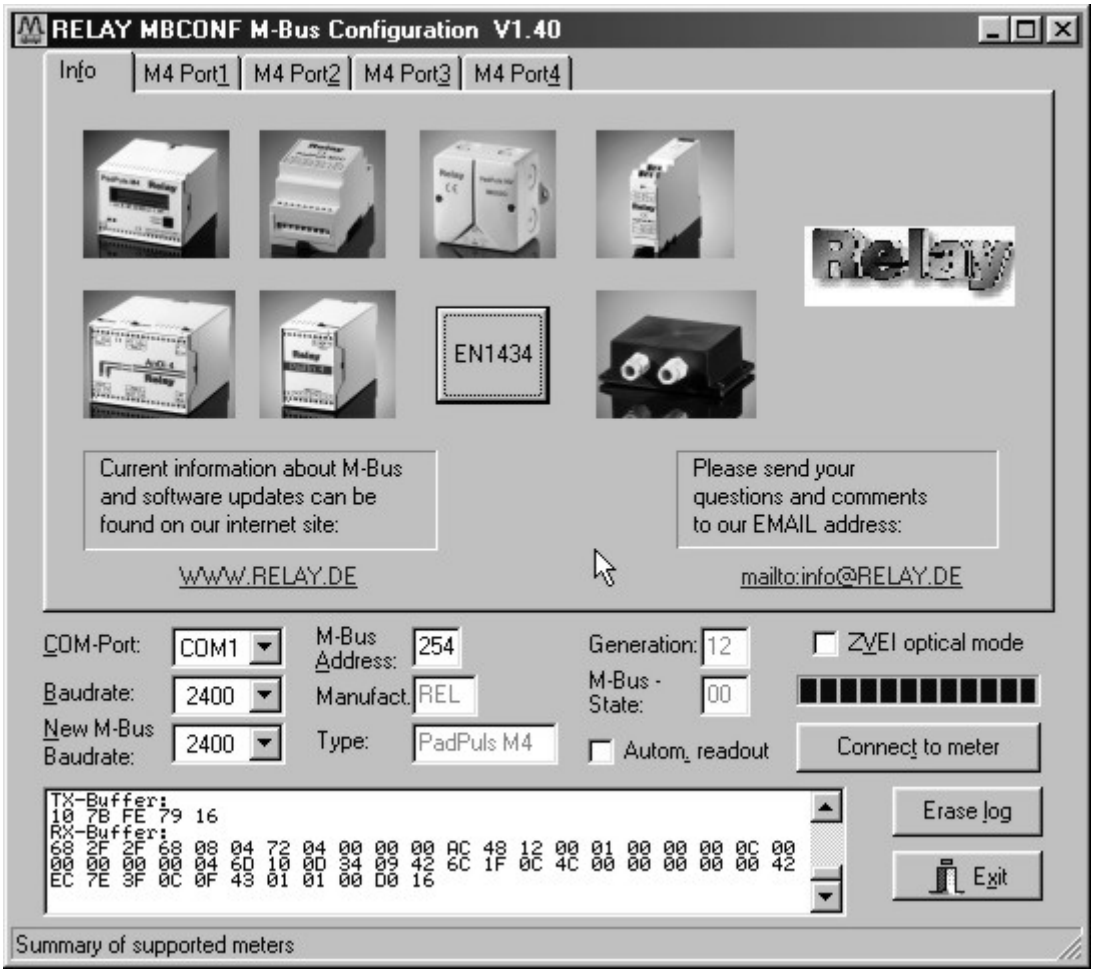
Please start the file “MBCONF_SETUP.EXE” from Windows Explorer or via “Start – Execute” to install the software from version 1.40 up. Subsequently you select the language of the installation procedure. The setup software can create a program group and a link on the desktop on demand. You can then execute both versions for German and English language either from start menu or desktop.

3.2 Operation

After program start the user operates the software according to the Windows conventions with the mouse or the keyboard. If you stay with the mouse on a button or an input field, then a hint to its function appears. Light-grey fields and boxes are not capable for editing.
All input fields and buttons have an underlined letter. The function can be activated by simultaneous pressing of the keys [ALT] and the respective letter. Within dialogs the cursor can be moved with the keys [TAB] or [SHIFT][TAB] forwards and back. [SPACE] activates or deactivates selection boxes. Multiple selection boxes (arrow at the right edge) can be activated with [⇓]. The user then selects an entry with [⇓] and [⇑]. By pressing [RETURN] the selected entry is taken over. With [ESC] the selection box is left without transfer.

The program is arranged as a sheet system. The sheet “Info” contains general options of the communication with the M-Bus device to be configured. In this sheet the user can select the serial port of the PC, the baudrate of the PC, the baudrate of the M-Bus device and the M-Bus primary address which is used for communication. After a successful connection with the M-Bus device, further manufacturer information is shown in the sheet “Info” and additional device-specific sheets are displayed.

3.3 Sheet Info



This sheet shows some photos of supported M-Bus devices from the product range of the Relay GmbH, the PadMess GmbH and further manufacturer. Here are also links to the Internet page, from which the current version of the program can be downloaded, and to the email address for criticism and suggestions to the program.

The lower third of this card is likewise visible in every other card. Here the following input fields and buttons are always attainable:

COM-Port is the serial port of the PC to which the M-Bus level converter is connected. The selected port will be saved in an INI file and will be restored on startup. Therefore the COM-Port has to be configured only once.

Baudrate ist the transmission speed of the serial port of the PC used for parameterization. Possible selections for this used M-Bus baudrate are 300, 2400 or 9600 baud. Attention: Baudrates of more than

2400 baud are not supported by all M-Bus level converters which are available on the market! The selected baudrate must be identical to the baudrate of the M-Bus device. (see: “New M-Bus Baudrate”). The PadPuls M4L supports the baudrates 300 and 2400 Bd.

New M-Bus Baudrate allows reprogramming the baudrate of the M-Bus device. The new baudrate is sent to the M-Bus device after a change in the appropriate selection box. If the M-Bus slave accepts this command, it acknowledges the telegram with the single character „$E5“ ($ for hexadecimal notation) using the old baudrate. Afterwards the device switches to the new baudrate. This button is not needed for the PadPuls M4L, since it automatically detects the baudrate used by the master.

M-Bus Address is the primary address of the connected M-Bus slave. In a direct connection with only one slave you can use the broadcast address 254. Using this address every M-Bus device must answer regardless of its own address.

Connect to meter is used to request data from the slave. The type of device is then automatically recognized. The items “Manufact.”, “Generation”, “Type” and “M-Bus State” will then be refreshed. New sheets are generated depending on manufacturer and type of the M-Bus device. A single sheet for each channel appears in case of PadPuls M4L. The sheets are labelled “M4 Port1” for the first … “M4 Port4” for the fourth channel.

Manufact. is an item that shows the 3-letter manufacturer code after successful reading (“Connect to meter”). The item is read only.

Generation shows the software revision of the firmware of the connected M-Bus device. The item is read only.

Type shows the type (here: PadPuls M4) of the connected device. This item is read only.

M-Bus State shows the M-Bus state of the connected device. This item is read only.

ZVEI optical mode If this option is activated, devices with an optical interface and protocol according to EN 1434-3 can be read and programmed using an optical reading head (e.g. PadPuls M4 / M4L).

Autom. readout The software always reads the data after writing, if this option is activated (useful for checking the correct programming).

Log-Window

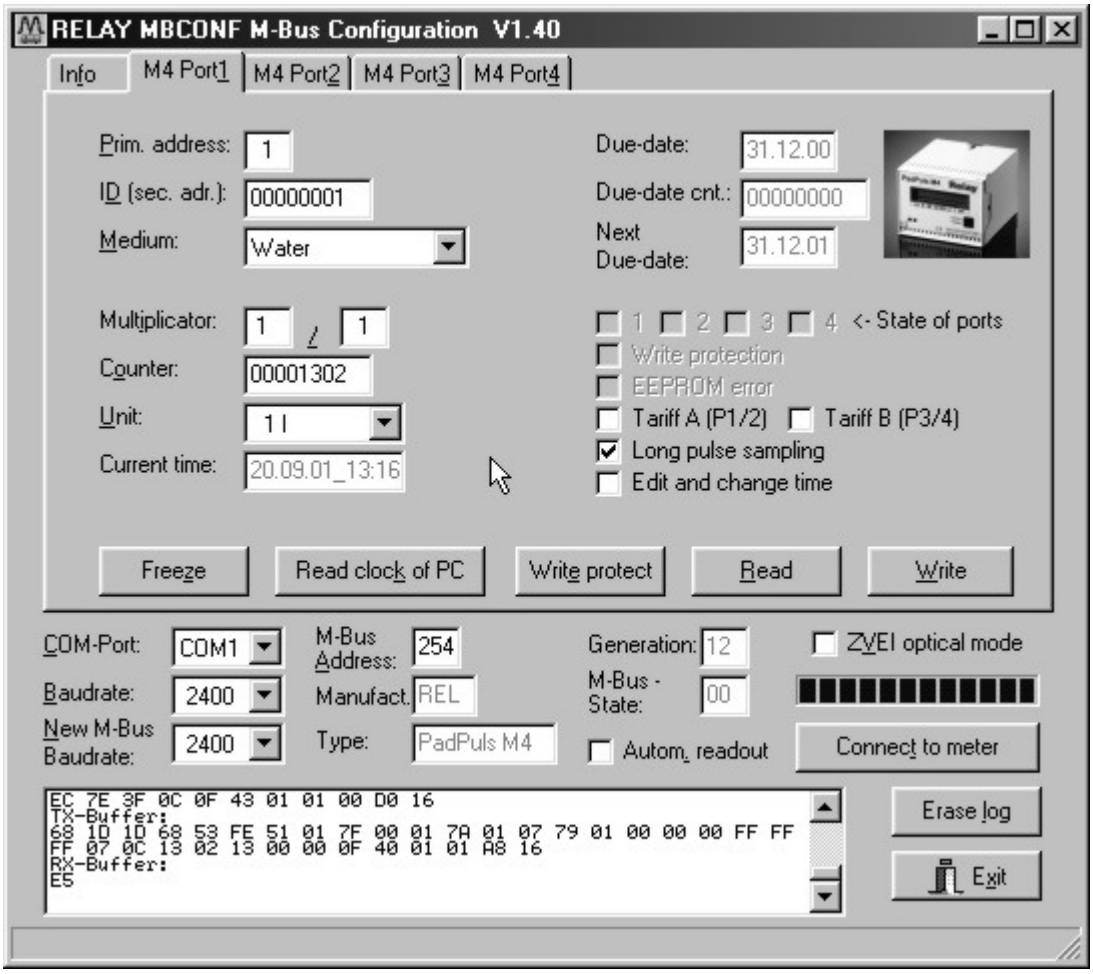
The so-called log window is always visible. All M-Bus communication steps are logged in this window. Data is displayed in hexadecimal notation. It is possible to mark outputs in the log window and copy them with the keys “CTL-C” to the windows clipboard. Then the data can be easily imported to any text editor for documentation. As soon as the max. storage capacity of the window is achieved, no more data is logged. If you want to log further, you must delete the logged data.

The following buttons are also always visible:

Erase log clears all outputs inside the log window.

Exit terminates the program and stores the current setting of serial port (port no.) into the INI file.

3.4 Sheets M4 Port1 to M4 Port4



These sheet shows the current settings and values of the respectively pulse channel (port) of the PadPuls M4L (in this example: Port 1). The following input boxes and buttons are used to change the params of the pulse adapter:

Primary address is the M-Bus address of the selected port. Values between 1 and 250 can be entered in this field for new assignment of the address. After pressing the “Write” button the software programs this primary address and further variable settings on this sheet into the M-Bus device.

ID (sec. adr.) is the 8 digit M-Bus ID (identification no.), which is also used for secondary addressing of this port.

Medium describes the measured medium of the connected meter. Examples: Oil, Water, Heat, Electricity

Multiplicator is the pulse increment (multiplicator) of the connected meter. For each registered pulse the device adds “multiplicator” to the counter. The numerator can take values between 0 (no counting) and 99, the denominator between 1 and 256.

Unit is the physical unit of the counter and of the pulse increment. All proper units including variants with power of ten from the DIN EN 1434-3 are offered in the selection list.

Counter is the accumulated counter. It has to be related to the unit mentioned above. The counter can be programmed equal to the counter of the connected meter in a range of 0 to 99999999.

Current time is the current date and time-of-day of the internal clock in the format DD.MM.YY_hh.mm. This field can be only edited and modified in the PadPuls, if the switch “Edit and change time” is activated. The button “Read clock of PC” transfers once the current date and time of the PC into this window. The time-of-day and the date always apply to all ports of PadPuls M4L.

Due-date is the last due-date (date of the last storage of the due-date counter) in the format DD.MM.YY. This field is read only.

Due-date cnt. is the counter which was saved at the due-date. This field is read only.

Next Due-date is the next (future) due-date (date of the next storage of the counter) in the format DD.MM.YY. The counter will be saved at 00:00, e.g. with due-date 01.01 at change from 31th of December 23:59 to 1st of January 00:00. This field can be edited and programmed only, if the switch “Edit and change time” is marked. The due-date always applies to all ports of PadPuls M4L.

State of ports shows the current input state of all ports (a closed contact is marked). This item is read only.

Write protection is marked, if the device is protected against programming. Then you cannot configure the adapter. The protection can be removed after opening the sealable housing and pressing the “Unprotect” pushbutton for a minimum of 4 seconds.

EEPROM error is marked, if there was an error while reading the non-volatile memory. In this case you must reconfigure the device.

Tariff A (P1/2) is used for activation tariff mode on port 1 and 2. The tariff mode will be selected after pressing the “Write” button, if the check box is marked. Port 1 is then used as pulse input and port 2 is the tariff switch. With an open tariff switch the pulses are accumulated to the counter for port 1 (main tariff). With a closed tariff contact the pulses increment the counter for port 2 (special tariff).

Tariff B (P3/4) is used for activation tariff mode on port 3 and 4. The tariff mode will be selected after pressing then “Write ” button, If the check box is marked. Port 3 is then used as pulse input and port 4 is the tariff switch. With an open tariff switch the pulses are accumulated to the counter for port 3 (main tariff). With a closed tariff contact the pulses increment the counter for port 4 (special tariff).

Long pulse sampling activates a longer charging of the contacts before sampling the inputs. This allows higher capacitors and / or many pulse generators with So interface (photocoupler with capacitors) to be connected. On delivery the extended pulse sampling is activated. The lifetime of battery is increased for about 15% if this feature is not used.

Edit and change time activation of this check box allows editing and programming of the “Current time” and “Next due-date”. The checkbox is deactivated automatically after successful configuration with “Write”.

Freeze transmits a command to the PadPuls M4L telling it to freeze the counters. The PadPuls M4L then copies the current counter to the “Due-date counter” and the current date to the (last) “Due-date”. The storage is done for all ports simultaneously. This the same behaviour as at due-date. The freeze command can be used with the broadcast address 255 to order all PadPuls to save the current counters. Then the M-Bus master has enough time to read all meters and get values of the same time (reading profiles).

Read clock of PC once gets the current date and time from the clock of the PC and transfers it into the item “Current time”.

Write protect Transmits a command to the PadPuls M4L to activate write protect. The PadPuls M4L then allows no further configuration. It is protected against unnoticed manipulation.

Read reads the M-Bus device and refreshes the data on the selected sheet.

Write sends the current options to the pulse converter, which saves this data into the non-volatile memory. The PadPuls M4L changes the options only if the write protect is deactivated. It is recommended to read the data after writing and check it.

Notes:

1. The variables „Current time“, „Next due-date“, „Write protection“, „Long pulse sampling “ and the command „Freeze“ always apply to all ports. Therefore you need to edit these items only in one sheet. The write protect should be activated after successful configuration of all ports.
2. Please press first the button „Connect to meter“ after connecting a new M-Bus device. Afterwards all sheets are refreshed.
3. Examples for configuration of pulse increment and unit:
   - Water meter with counter = 45120 l and 1 Pulse = 10 l:
     Choice 1: Unit = 10 l, Multiplicator = 1 / 1, Counter = 4512 (x 10 l)
     Choice 2: Unit = 1 l, Multiplicator = 10 / 1, Counter = 45120 (x 1 l)
   - Electricity meter with counter = 78346 kWh and 64 pulses / kWh:
     Choice: Unit = 1kWh, Multiplicator = 1 / 64, Counter = 78346 (x 1kWh)
   - Electricity meter with counter = 112,345 kWh and 1000 pulses / kWh:
     Choice: Unit = 1Wh, Multiplicator = 1 / 1, Counter = 1123454 (x 0,001Wh)
4. With activated tariff option the pulses are evaluated with the adjustments of the respective port. Therefore you should take care that both ports have the same pulse increment and unit.

4 Notes on malfunctionings

Error	Possible source of error
No function in battery mode	- Battery jumper is not placed - Battery is empty (voltage min. 2.9V)
No function after installation, although the battery jumper is placed and the M-Bus is connected	- After placing the jumper a reset is generated using an R/C combination. It is possible that the reset was not correct. Please lift the jumper, wait about 10 seconds and place it again.
Pulses are not counted or wrong	- Check connection of the pulse meter - Activate the „extended pulse sampling" if your system has: a) long cables (> 10m) b) high capacitors c) electronic S_0 interface - Check configuration (especially pulse increment and tariff mode)

5 M-Bus Telegrams

Position	1	2	3	4	5	6	7	8	9	10	11	12
Name:	Start	Length	Length	Start	C	A	CI	ID_0	ID_1	ID_2	ID_3	Man_0
Value (hex):	68	2F	2F	68	08		72					AC

13	14	15	16	17	18	19	20	21	22	23	24	25	26
Man_1	Gen	Med	TC	State	Sig_0	Sig_1	DIF1	VIF1	$Stand_0$	$Stand_1$	$Stand_2$	$Stand_3$	DIF2
48					00	00	0C						04

27	28	29	30	31	32	33	34	35	36	37	38	39	40
VIF2	$Date_0$	$Date_1$	$Date_2$	$Date_3$	DIF3	VIF3	$LeStD_0$	$LeStD_1$	DIF4	VIF4	$StStn_0$	$StStn_1$	$StStn_2$
6D					42	6C			4C				

41	42	43	44	45	46	47	48	49	50	51	52	53
$StStn_3$	DIF5	VIF5	VIFE5	$StDat_0$	$StDat_1$	DIF6	Info	Numerator	Denominator	PStat	CS	Stop
	42	EC	7E			0F						16

RSP_UD telegram

A: primary address
ID_{0-3}: identification no. for secondary addressing
Man_{0-1}: manufacturer code
Gen: revision of firmware (at this time $12, reserved range: $10 .. $1F)
Med: medium
TC: transmission counter (number of transmitted RSP_UD)
State: most significant bit set (bit 7) -> write protected
bit 3 set (permanent error) -> error in EEPROM data
VIF1=VIF4: selected VIF (value information field -> physical unit)
Stand: current counter
Date: current date (IEC870-5-4: data type F)
LeStD: last due-date, date of the due-date counter (IEC870-5-4: data type G)
StStn: due-date counter
StDat: next (future) due-date
Info: 1 byte with information about tariff and sampling method)
Numerator: numerator of pulse increment(1..99)
Denominator: denominator of pulse increment (1..255, 0 -> 256)

$$1\ Pulse = \frac{Numerator}{Denominator} * VIF$$

PStat: state of inputs (current input state of the ports)

Byte 48 (Info)

Bit	7	6	5	4	3	2	1	0
Value (bin)	x	Sampling	Tariff B	Tariff A	0	0	Select1	Select0

Select: number of the port, for which the data is valid
00: Port1, 01: Port2, 10: Port3, 11:Port4
Tariff A: tariff A (Port 1 = count input, Port2 = counter / tariff signal)
0: tariff off (Port2=count input), 1: tariff on (Port2=tariff signal)
Tariff B: tariff B (Port 3 = count input, Port4 = counter / tariff signal)
0: tariff off (Port3=count input), 1: tariff on (Port4=tariff signal)
Sampling: duration of a sampling
0: short (0.5ms), 1: long (1.5ms)

Position	1	2	3	4	5	6	7	8	9	10	11	12
Name:	Start	Length	Length	Start	C	A	CI	DIF1	VIF1	Anw.	DIF2	VIF2
Value (hex):	68			68	53		51	01	7F		01	7A

13	14	15	16	17	18	19	20	21	22	23	24	25	26
PAdr	DIF3	VIF3	ID_0	ID_1	ID_2	ID_3	Man_0	Man_1	Gen	Med	DIF4	VIF4	$Stand_0$
	07	79					AC	48			0C		

27	28	29	30	31	32	33	34	35	36	37	38	39	40
$Stand_1$	$Stand_2$	$Stand_3$	DIF5	VIF5	$Date_0$	$Date_1$	$Date_2$	$Date_3$	DIF6	VIF6	$StDat_0$	$StDat_1$	DIF7
			04	6D					42	6C			0F

41	42	43	44	45
Opt.	Numerator	Denominat.	CS	Stop
				16

SND_UD telegram (Abbreviations see RSP_UD)

Port: seleced port (used with address 254)
0=Port1, 1=Port2
PAdr: new primary address of the port
Numerator: Numerator of pulse increment (1..99, BCD format)
Denominator: Denominator of pulse increment (1..255, 0 -> 256, binary fromat)
Option: Options (tariff, sampling). Coding like Info (Byte 48 RSP_UD).

The PadPuls M4L analyzes the individual data records on the basis of the DIF. Therefore the order of the records is allowed to vary. It is also possible to transmit only parts of the SND_UD specified above. The manufacturer-specific appendix of the telegram is always first analysed and must be included therefore in any case. The optional record „DIF1 VIF1 Anw“ selects a port to be addressed with global address 254. This must be always the first record in the telegram.

Position	1	2	3	4	5	6	7	8	9	10	11
Name:	Start	Length	Length	Start	C	A	CI	DIF	Prot.	CS	Stop
Value (hex):	68	05	05	68	53		51	0F	55		16

Protection-Telegram

This telegram activates the write protection.

Position	1	2	3	4	5	6	7	8	9	10	11
Name:	Start	Length	Length	Start	C	A	CI	DIF	Anw.	CS	Stop
Value (hex):	68	05	05	68	53		51	0F			16

Select telegram (old method)

Position	1	2	3	4	5	6	7	8	9	10	11
Name:	Start	Length	Length	Start	C	A	CI	DIF	VIF	Anw.	CS
Value (hex):	68	06	06	68	53		51	01	7F		

12
Stop
16

Select telegram (new method)

Anw. specifies the Port of the PadPuls M4L, which answers to a REQ_UD2 at address 254:
Port1: Anw=00
Port2: Anw=01
Port3: Anw=02
Port4: Anw=03

Position	1	2	3	4	5	6	7	8	9
Name:	Start	Length	Length	Start	C	A	CI	CS	Stop
Value (hex):	68	03	03	68	53		54		16

Freeze telegram

On reception of this telegram the pulse adapter saves the current counters of all ports into the due-date counters and the current date into the due-date.

6 Technical Data

Case

Mounting	DIN rail according to DIN EN 50022 or wall
Material	ABS plastic
Colour	light-grey (similar RAL 7035)
W x H x D	(55 x 75 x 105) mm
Protection type	IP40

Environment

Operating temperature	0 to 55 °C
Storage temperature	-20 to 60 °C
Humidity (non condensing)	10% to 70%

Specifications to contacts of pulse generators

Potential	floating, insulation to earth > 1MΩ
Resistance	open > 1MΩ, closed < 2kΩ
Maximum capacity (incl. cable)	2nF (short sampling), 12nF (long sampling)
Minimum contact duration	30 ms
Minimum pause between contacts	30 ms
Maxium pulse frequenz	14 Hz

Specifications to contact of tariff generator

Potential	floating, insulation to earth > 1MΩ
Resistance	open > 1MΩ, closed < 2kΩ
Maximum capacity (incl. cable)	2nF (short sampling), 12nF (long sampling)
Possible signal wave forms	50 / 60 Hz or static signals

PadPuls contact input:

Contact voltage	2.5V to 3.6V
Contact current	30 μA
Guaranteed debounce time	5.0 ms
Connection cable	maximum 10 m (Twisted Pair recommended)

Current consumption

Principle	remote power supply from M-Bus with automatic changeover to battery on bus failure
Bus operation	max. 3.0 mA (2 unit loads), no battery loading
Battery standard optional	Lithium 3V, type 2/3 AA, 1800mAh, exchangable Lithium 3V, type C, 5000mAh
Battery operation	at 25°C ca. 60µA (long sampling)
Battery lifetime in battery operation	standard battery: at 25°C ca. 3 years optional battery: at 25°C ca. 8 years
Short sampling	Battery lifetime is lengthened by ca.15% if short sampling is activated.

M-Bus: physical characteristics

M-Bus quiescent current	typ. 2.75 mA, max. 3.0 mA (2 unit loads)
Space(0-Bit) current	quiescent current (1.4 mA) + typ. 13 mA
M-Bus Interface	TI TSS721 with 2 x 215Ω protection resitors

M-Bus Protocol

Standard	EN1434-3
Transmission speed	300, 2400 baud with automatic detection
Addressing	Primary- and secondary addressing with wildcards, per input port : 1 primary and 1 secondary address
Supported functions	SND_NKE, REQ_UD2, SND_UD, ignores FCB-Bit (according to EN1434-3)
Data structure	variable structure, Low-Byte-First (CI: 72h) length = 53 Bytes 1. data record: counter 2. data record: date and time 3. data record: last due-date 4. data record: last due-date counter 5. data record: next due-date 6. data record: manufacturer specific data
Configuration telegram	Identification no., medium, primary address, pulse increment, pulse unit, initial counter, tariff mode, date / time and next due-date: can be parameterized via SND_UD through M-Bus or optical interface